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Five new species of *Nolana* (Solanaceae-Nolaneae) from Peru and notes on the classification of additional taxa

Cinco nuevas especies de *Nolana* (Solanaceae-Nolaneae) de Perú y notas en la clasificación de taxa adicionales

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Abstract

In preparation for the publication of a monographic treatment of *Nolana* (Solanaceae-Nolaneae), five new species are described from Peru: ***N. aenigma*** M.O. Dillon, S. Leiva & Quipuscoa, ***N. arequipensis*** M.O. Dillon & Quipuscoa, ***N. chancoana*** M.O. Dillon & Quipuscoa, ***N. chapiensis*** M.O. Dillon & Quipuscoa, and ***N. lezamae*** M.O. Dillon, S. Leiva & Quipuscoa. *N. lezamae* and *N. chapiensis* are distributed in the western Andean Cordillera at 2100 - 2350 m and the others are recorded from the coastal *lomas* formations below 500 m. Distribution and ecology, species relationships, and notes on the classification of additional taxa are discussed.

Key Words: *Nolana*, Nolaneae, new species, Peru, Solanaceae

Resumen

En la preparación para la publicación de un tratamiento monográfico de *Nolana* (Solanaceae-Nolaneae), se describen cinco especies nuevas de Perú: ***N. aenigma*** M.O. Dillon, S. Leiva & Quipuscoa, ***N. arequipensis*** M.O. Dillon & Quipuscoa, ***N. chancoana*** M.O. Dillon & Quipuscoa, ***N. chapiensis*** M.O. Dillon & Quipuscoa, y ***N. lezamae*** M.O. Dillon, S. Leiva & Quipuscoa. *N. lezamae* y *N. chapiensis* habitan en las Vertientes Occidentales de los Andes desde los 2100 hasta los 2350 m de elevación y las demás especies crecen en las lomas de la costa. Así mismo, se discuten las relaciones con otras especies afines, se incluyen datos de distribución geográfica, ecológica y se adicionan notas acerca de la clasificación de este género.

Palabras Clave: *Nolana*, especies nuevas, Peru, Solanaceae

Introduction

Nolana (Solanaceae-Nolaneae) is a genus of 89 species, including the five described here, which inhabits a variety of arid and semi-arid habitats throughout the Atacama and Peruvian deserts (Dillon 2005). No fewer than 43 species have been reported from Peru, four of which have distributions into northern Chile (Dillon et al. 2007a, b). The greatest species diversity is confined to near-ocean localities termed *lomas* formations, usually between 50—800 m elevation and within 50 kms of the shoreline (Rundel et al., 1991; Dillon, 1997; Dillon et al. 2003). A few species, such as *N. urubambae* Vargas, *N. chapiense* sp. nov., and *N. lezamae* sp. nov. are distributed above 2000 m at a distance of 50-500 kms inland from the coast. Most species are narrow endemics, with small, restricted geographic ranges and specific ecological requirements, but a few species have larger geographic distributions, for example, *N. humifusa* (Gouan) I.M. Johnst. (8°-12°20'S or over 500 kms) and *N. spathulata* Ruiz & Pav. (15°-18°S or over 550 kms).

Within the *lomas* formations, *Nolana* stands out as one of the most wide-ranging, conspicuous elements of the coastal Peruvian and Atacama flora (Dillon, 2005). *Nolana* species are often important members of their respective communities and can occur in large populations at very high densities. The component taxa form a well-defined and obviously monophyletic group diagnosed by a unique ovary forming mericarps or schizocarps with 1-7 seeds per segment (Knapp, 2002). Field studies, over the last 25 years, have yielded several novelties that are morphologically and ecologically distinctive. For a full discussion of relationships as suggested by molecular studies consult Dillon et al. (2007b).

1. ***Nolana aenigma*** M.O. Dillon, S. Leiva & Quipuscoa, sp. nov. (Fig. 1-3).

TYPE: PERU. **Dpto. La Libertad**, Prov. Trujillo, Dist. Trujillo, Km 580, Cerro Cabezón, 10 Feb 1998, *S. Leiva G., M. O. Dillon, A. Sagástegui A., & V. Quipuscoa S. 2165* (holotype, HAO; isotype, F, HUT).

Species insignis, foliis aliquae formae N. paradoxa *similis, a habitu erecto, corollis minoribus differt, a specie sympatris* N. humifusae *differt habitu erecto, foliis cordiformibus vel reniformibus, calycibus lobis glabris non calcaribus, antheris glabris.*

Succulent, annual herbs; stems erect, 40 cm long, much-branched, glabrous. Leaves alternate, petiolate, the petioles 1-1.5 cm, the blades cordate to reniform or ovate, 1.5-2.5 cm long, 1.5-2.5 cm wide, glabrous, succulent, entire, apically obtuse to rounded, the bases obtuse to cordate. Inflorescences of solitary flowers in upper leaf axils, peduncles stout, glabrous, 1.5-2 cm long; calyx campanulate, 4-4.5 mm wide at anthesis, glabrous, 5-lobed, the lobes lanceolate, equal, 4.5-5 mm long, 2-2.5 mm wide, the apices acute, pencillate; corollas campanulate, ca. 12 mm wide, ca. 8 mm long, purple to lavender, the throat deep purple, internally glabrous, externally pubescent along the nerves, the trichomes uniseriate; stamens 5, included, filaments inserted on lower third of corolla, equal, 4-4.5 mm long, pilose at the bases; anther theca ca.1.5 mm long, ca. 1.5 mm wide, purple, glabrous. Ovary glabrous, ca. 1 mm long, ca. 1-1.5 mm wide, basal nectar ca. 2 mm wide, 5 carpels, the style included, 4.5-5 mm long, the stigma lateral, green, ca. 1.5 mm long. Mericarps, 5, immature.

Flowering: February.

Etymology: The specific epithet is derived from «enigma,» defined as a puzzling or inexplicable occurrence or situation. During our field studies in the El Niño year of 1998, we only encountered one individual of this species in the field, despite repeated efforts to locate additional material at the type locality. Subsequent years have not witnessed expansive flowering in northern Peru and the next El Niño event may present an opportunity to re-encounter this distinct species.

Distribution and ecology: This taxon is only known from the type locality at the base of Cerro Cabezón ca. 20 kms north of Trujillo. It was collected within a dense, flourishing population of *Nolana humifusa* that was covering the lower slopes of Cerro Cabezón during this period of intense influence from the ongoing 1997/98 El Niño phenomenon.

Relationships: This species is distinctive among its congeners in Peru, especially in its erect habit with basal branching and in having short corollas that barely surpass the calyx lobes. Only *Nolana adansonii* (Roemer & Schultes) I.M. Johnst. approaches *N. aenigma* in possessing an erect habit, however, the former is easily distinguished by its purple stems, 10-15 small mericarps, and a distribution restricted to southern Peru and northern Chile. The cordate to reniform leaf blades superficially resemble those found in *Nolana paradoxa* Lindl. of central and southern Chile; however, that species has an essentially prostrate habit, much larger flowers and 15-20 mericarps. This species has not been included in the molecular studies to date (Dillon et al., 2007b).

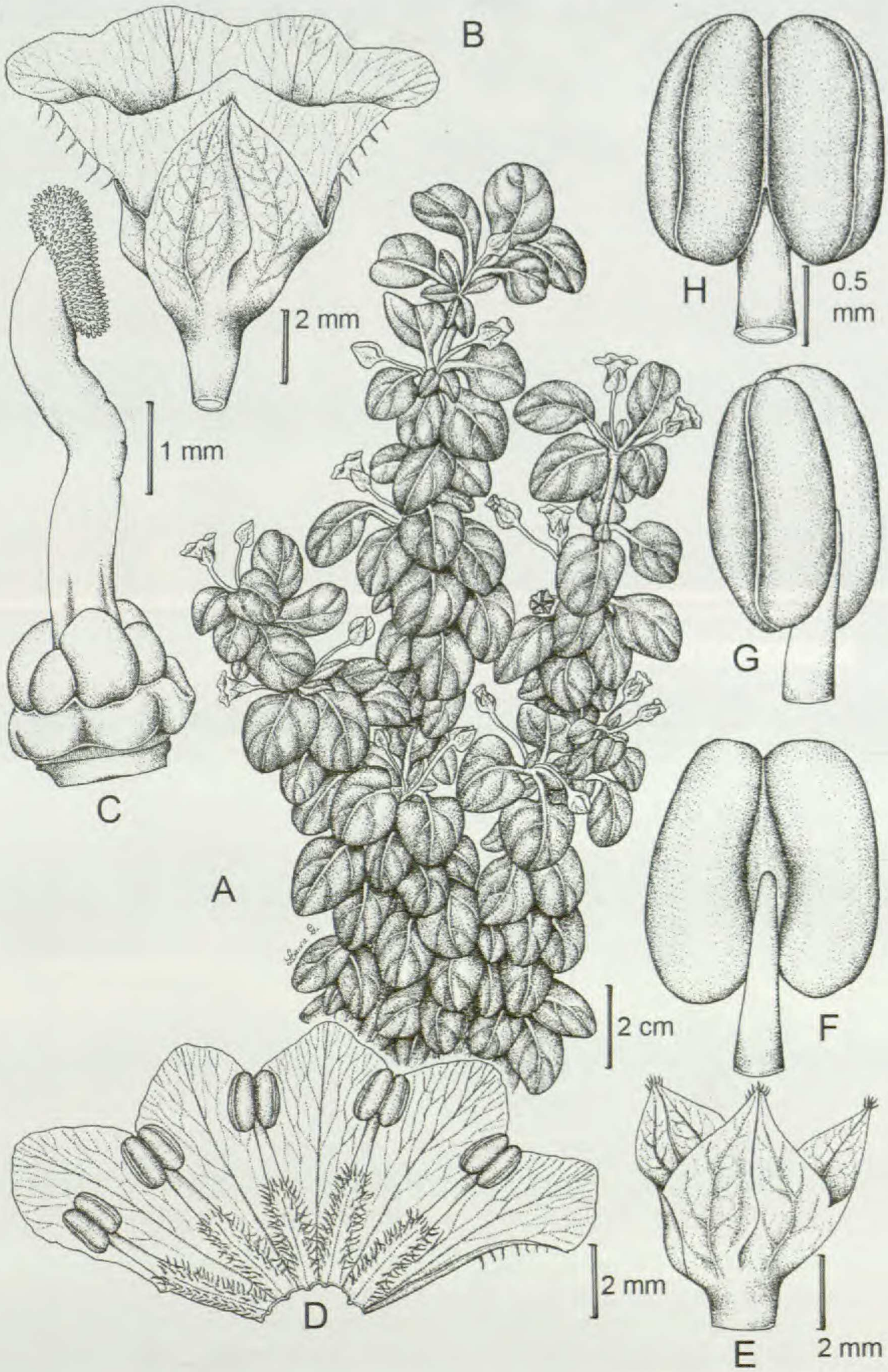

Fig. 1. *Nolana aenigma* M.O. Dillon, S. Leiva & Quipuscoa. A. Habit; B. Flower; C. Calyx; Gynoecium; D. Dissected corolla; E. Anther dorsal view; F. Anther lateral view; G. Anther ventral view; H. Gynoecium. (Drawing from Leiva et al. 2165, F).

Fig. 2. *Nolana aenigma* M.O. Dillon, S. Leiva & Quipuscoa. Photograph of holotype material of *Leiva et al. 2165* (HAO).

.Fig. 3. *Nolana aenigma* M.O. Dillon, S. Leiva & Quipuscoa. Photograph of holotype material of *Leiva et al. 2165* (HAO).

2. ***Nolana arequipensis*** M.O. Dillon & Quipuscoa, sp. nov. (Fig. 4).

TYPE: PERU. **Dpto. Arequipa**. Prov. Caravelí. Dist. Bella Unión, Sur de Nazca entre Km 518 y Km 590, [15º26'S, 74º52'O], 80-310 m, 13 Nov 2005, *M.O. Dillon, J. Wen, V. Quipuscoa, E. Ortiz, M. Corrales & G. Castillo 8790* (holotype: HUSA; isotypes: F, HAO, HUT, US, USM).

Nolana thinophilae *affinis, sed floribus minoribus, corollis albis, mericarpiis solum duobus.*

Succulent, perennial herbs; stems prostrate, 25-50 cm long, much-branched, glabrous. Leaves alternate to subopposite, sessile to short-petiolate, 1-3 mm, the blades obovate to oblanceolate, 10-20 mm long, 2-4 mm wide, glabrous, succulent, terete, entire, apically obtuse, bases cuneate. Inflorescences of solitary flowers in upper leaf axils, peduncles filiform, glabrous, 5-10 mm long; calyx tubular, 2-3 mm wide at anthesis, glabrous, the tube ca. 5 mm long; bilobed, the lobes deltoid, equal, 1-2 mm long, 1-2 mm wide; corollas hypocrateriform to tubular, 6-12 mm wide, white, internally light purple, veined, glabrous, externally glabrous, the tube 7-12 mm long, ca. 2 mm wide, 5-lobed, the lobes acute, 5-8 mm long, 2-4 mm wide; stamens 5, filaments inserted on lower third of corolla, unequal, three 2-3 mm long, two 3.5-4.5 mm long, pilose at the base; anther thecae 1-1.5 mm long, 0.8-1.2 mm wide, white, glabrous. Ovary glabrous, ca. 0.8 mm long, ca. 1 mm wide, basal nectar ca. 1.5 mm, 2 carpels, the style included, ca. 8 mm long, the stigma capitate, green, ca. 0.5 mm in diameter. Mericarps 2, equal, strongly united, included within the expanding calyx; mericarps each with 4-6 seeds, ca. 6 mm long, ca. 5 mm wide, the embryo curved, ca. 2 mm long. **Flowering**: October-November.

Distribution and ecology: *Nolana arequipensis* is distributed from 15°15'S to 16°15'S (ca. 160 Kms) along the southern coast of Peru, and is found in sandy soils at elevations between 100-300 m. These areas receive moisture from seasonal fog and support *lomas* vegetation including the following associates, *Nolana spathulata*, *N. plicata* I.M. Johnst., *N. tovariana* Ferreyra, *Hoffmannseggia prostrata* Lag. ex DC., *Encelia canescens* Cav., *Suadea foliosa* Moq., *Heliotropium krauseanum* Fedde, and *Tiquilia* sp.

Relationships: Material of this taxon was previous classified under *Nolana thinophila*; however, that species has larger purple corollas, five mericarps, and tends to be distributed in localities in close proximity to the ocean (>20 m). Overall habit and leaf morphology of *N. arequipensis* suggests relationships with *N. thinophila*, since they share similar terete, succulent leaves and prostate stems. Utilizing the GBSSI or waxy marker (Dillon et al., 2007b), *N. arequipensis* is shown to be related to, but not the sister species of *N. thinophila*. It is recovered in a well-supported clade with several other southern Peruvian taxa, including *N. confinis* (I.M. Johnst.) I.M. Johnst., *N. johnstonii* Vargas. *N. pallida* I.M. Johnst., *N. lycioides* I.M. Johnst., *N. gayana* (Guadich.) Koch, *N. cerrateana* Ferreyra. *N. pilosa* I.M. Johnst., *N. volcanica* Ferreyra. *N. tomentella* Ferreyra, and *N. thinophila* I.M. Johnst.

Unusual morphotypes have been observed in the region of the type locality that may represent the products of hybridization events. The molecular data also suggest some hybridization and/or introgression may have occurred, given that one clone of *N. arequipensis* (Dillon et al. 8790, clone 1) is recovered in a clade containing *N. gayana* and *N. tomentella* (Dillon et al., 2007b). The other clones of *N. arequipensis* group together and are sister taxa.

The highly reduced gynoecium composed of only two large, fused mericarps (Fig. 5C), is not seen among any other extant Peruvian *Nolana*. It is notable that the *Nolana* species which do occur sympatrically, i.e., *N. spathulata*, *N. plicata* I.M. Johnst. and *N. tovariana* Ferreyra, are more distantly related and found in a clade with *N. chancoana*, *N. weissiana* Ferreyra and *N. inflata* Ruiz & Pav. Further sampling and analysis are needed to more fully understand relationships within these southern Peruvian species.

Additional material examined: Peru. **Dpto. Arequipa**: Prov. Camaná, Lomas of Ocoña, ca. 285 m, 4 Nov 1983, *M.O. Dillon & D. Dillon 3861* (F). Prov.

Caravelí, Lomas of Jahuay, ca. 300 m, 1 Nov 1983, *M. O. Dillon & D. Dillon 3768* (F); ca. 31 km S of Atico, 110-140 m, 4 Nov 1983, *M. O. Dillon & D. Dillon 3851* (F); Tres Hermanos, near Jahuay, ca. 15 km toward coast from PanAmericana Hwy, 5 Oct 1984, *Ohga* (MAK225311); hilltop between Jahuay and San Juan, 18 Oct 1984, *Oka* (MAK229699); Bella Unión, Sur de Nazca entre Km 518 y Km 590, 80-310 m, 13 Nov 2005, *M.O. Dillon, J. Wen, V. Quipuscoa, E. Ortiz, M. Corrales & G. Castillo 8793* (F, HAO, HUSA, HUT, US, USM); Alto Grande, Km 525 Panamericana Sur cerca Lomas de Jahuay, 15° 24,4´S-74° 53,2´O, 321 m, 19 Nov 2007, *V. Quipuscoa, M.O. Dillon, E. Ortiz, L. Cáceres, M. Cueva, K. Durand, D. Ramos & N. Castro 3529* (F, HAO, HUSA, HUT, USM).

Fig. 4. *Nolana arequipensis* M.O. Dillon & Quipuscoa. Photographs of *Dillon et al. 8790* A. Habit; B. Lateral view of branch apex with flowers and leaves; C. Flowers and faciulate, succulent leaves; D. Close-up of corolla displaying zygomorphic lobes; E. Twin mericarps

3. ***Nolana chancoana*** **M.O.Dillon & Quipuscoa,** sp. nov. (Fig. 5-6).

TYPE: PERU. **Dpto. Arequipa.** Prov. Caravelí. Dist. Atico. Lomas of Atico, prostrate herb; flws. lavender, [16°14'S, 73°39'W], 2 Nov 1983, *M. O. Dillon & D. Dillon 3836* (holotype: HUSA; isotypes: F, HAO, HUT, MO, NY, US, USM).

Species notabilis, foliis linearibus succulentis, calycibus inflatis, formae corollis N. inflata *simile, differt formae foliis et inflorescentia.*

Succulent, annual herbs; stems prostrate, 12-50 cm long, much-branched, glabrous. Leaves alternate, short-petiolate, 1-3 mm, the blades linear to oblanceolate, 10-40 mm long, 2-6.5 mm wide, glabrous, succulent, trigonus, entire, apically acute to obtuse, bases cuneate. Inflorescences of solitary flowers in upper leaf axils, peduncles filiform, glabrous, 7-20 mm long; calyx suburceolate to campanulate, 7-15 mm wide at anthesis, glabrous, the tube 5-10 mm long; 5-lobed, the lobes deltoid, equal, 6-10 mm long, 4-8 mm wide; corollas infundibuliform, 15-20 mm wide, blue to violet, or whitish, internally deep purple, veined, glabrous, externally glabrous, the tube 12-17 mm long, 15-20 mm wide, 5-lobed, the lobes acute, 5-8 mm long, 2-4 mm wide; stamens 5, filaments inserted on lower third of corolla, unequal, three 2-3 mm long, two 3.5-4.5 mm long, pilose at the bases; anther thecae 1.5-2 mm long, 1-1.5 mm wide. Ovary glabrous, basal nectary, 5 carpels, the style included, the stigma capitate, green, ca. 1 mm in diameter. Mericarps 5, 8.5-9 mm in diameter, included within the expanding calyx; each with 1-3 seeds.

Flowering: (September) November-February (August).

Etymology: This species is named for Dra. Magda Chanco, professor of botany and curator at the Museo de Historia Natural 'Javier Prado' of the Universidad Nacional Mayor de San Marcos in Lima. She has worked tirelessly for her institution with undergraduate teaching and participation in graduate student education. Her friendship and cooperation with the authors has been an enduring quality and it is our great pleasure to dedicate this beautiful and distinctive species in her name.

Distribution and ecology: This species has a distribution of nearly 120 kms along the coast of southern Peru, from 15°50'S to 16°50'S. Associated *lomas* species include the following, *Heliotropium krauseanum*, *Heliotropium pilosum* Ruiz & Pav. (both Boraginaceae) *Grindelia glutinosa* (Cav.) Dunal, *Onoseris* sp., *Heterosperma ferreyrii* H. Rob. (all Asteraceae), *Nolana inflata*, *N. aticoana* Ferreyra (both Solanaceae), *Palaua dissecta* Benth. (Malvaceae), *Tetragonia* sp. (Aizoaceae), and *Croton alnifolius* Lam. (Euphorbiaceae).

Relationships: Material of this taxon had previously been placed under the name *Nolana coronata* Ruiz & Pav. by Ferreyra (1962); however, an examination of the type of that species and a visit to its type locality shows it to be distinct from *N. chancoana*. The former species is readily distinguished with its larger, ovate to lanceolate leaves with obvious petioles and only five angular mericarps with their interior faces united. For a fuller explanation of the classification of *N. coronata*, see the section on Taxonomic Notes.

Utilizing the GBSSI or waxy marker (Dillon et al., 2007b), *N. chancoana*, is grouped in a clade including the morphologically distinct *N. inflata*, *N. plicata*, and *N. weissiana*. The inflated calyx suggest those found in *N. inflata* and *N. weissiana*, however, the corollas in those species are deep purple and the leaves are larger, petiolate, and pubescent.

Additional material examined: **Dpto. Arequipa**, Prov. Camaná, Dist. Ocoña, Norte de Ocoña, ca. Km 767, 16° 26´S-73° 08´O, 300 m, 12 Nov 2005, *M.O. Dillon, J. Wen, V. Quipuscoa, E. Ortiz, M. Corrales & G. Castillo 8760* (F, HAO, HUSA, HUT, US, USM); 16° 16´S-73° 28´O, 300 m, 12 Nov 2005, *M.O. Dillon, J. Wen, V. Quipuscoa, E. Ortiz, M. Corrales & G. Castillo 8766* (F, HAO, HUSA, HUT, US, USM). Prov. Caravelí. Dist. Atico. Lomas of Atico, ca. 48 km SE of Chala, *M.O. Dillon, U. Molau, & P. Matekaitis 3262* (F); Lomas of Jahuay, *M.O. Dillon & D. Dillon 3772* (F); Lomas of Atiquipa, *M.O. Dillon & D. Dillon 3778* (F, USM); ca. 7 km N of Chala, 110 m, 21 Feb 1998, *M.O. Dillon, M. Tago, M. Zapata & L. Martell 8200* (F, HAO).

Fig. 5. *Nolana chancoana* M.O. Dillon & Quipuscoa. Isotype herbarium sheet of *Dillon & Dillon 3836* (F).

Fig. 6. *Nolana chancoana* M.O. Dillon & Quipuscoa. Photographs illustrating, A. Habit, B. Close-up laterial view of corolla and calyx; C. Corollas; D. Mericarps.

Entre Atico y Camaná, formación de lomas, [16°13.025S, 73°42.054W], 5 Nov 2005, *M. O. Dillon, J. Wen, V. Quipuscoa, E. Ortiz, M. Corrales & G. Castillo 8912* (F, HAO, HUT, HUSA, US, USM); Bella Unión, Sur de Nazca entre Km 518 y Km 590, 15° 26´S-74° 52´O, 80-310 m, 13 Nov 2005, *M.O. Dillon, J. Wen, V. Quipuscoa, E. Ortiz, M. Corrales & G. Castillo 8789* (F, HAO, HUSA, HUT, US, USM); Atico, entre Atico y Camaná, 16° 10´S-73° 48´O, 50 m, 15 Nov 2005, *M.O. Dillon, J. Wen, V. Quipuscoa, E. Ortiz, M. Corrales & G. Castillo 8912* (F, HAO, HUSA, HUT, US, USM); 16° 13´S-73° 42´O, 30 m, 15 Nov 2005, *M.O. Dillon, J. Wen, V. Quipuscoa, E. Ortiz, M. Corrales & G. Castillo 8914* (F, HAO, HUSA, HUT, US, USM); *M.O. Dillon, J. Wen, V. Quipuscoa, E. Ortiz, M. Corrales & G. Castillo 8919* (F, HAO, HUSA, HUT, US, USM); Lomas de Atico, 3 Dec 1955, *R. Ferreyra 11727* (USM); Lomas de Capcc, acerca a Chala, 3 Dec 1955, *R. Ferreyra 11745* (USM); PanAmerican Hwy. 652 S of Lima at «Cali» gas station (6 km S of Chala), Lomas de Capacc, 13 Sep 1957, 200 m, *P.C. Hutchison 1288* (USM); Atiquipa, Silaca, entre Tanaka y Atiquipa, 15° 48,7´S-74° 23,8´O, 291 m, 19 Nov 2007, *V. Quipuscoa, M.O. Dillon, E. Ortiz, L. Cáceres, M. Cueva, K. Durand, D. Ramos & N. Castro 3557* (F, HAO, HUSA, HUT, USM); Lomas acerca de Chala, 27 Aug 1957, Rahn 063 (USM); Atiquipa, Oct 1863, *Raimondi 10856* (USM); Km 586 Panamericana Sur, Lomas 6 km N of Atiquipa, 450-860 m, *Weigend & Förther 97/692* (F), *97/693* (F), *97/694* (F); Acarí, Lomas de Pongo, 2 Aug 1947, 300 m, *O. Velarde 523* (USM) .

4. ***Nolana chapiensis*** M.O. Dillon & Quipuscoa, sp. nov. (Fig. 7-9).

TYPE: PERU. **Dpto. Arequipa**, Prov. Arequipa, Dist. Polobaya. Entre La Gruta y el Santuario de Chapi, [16°45.51'LS, 71°19.72'LO], 2300 m, 25 Nov 2000, *V. Quipuscoa S. & L. Cáceres M. 2495* (holotype, HUSA; isotype, F).

Nolana laxa *vel* N. weberbauere *primo adspectu maxime simile, sed laminae foliis oblanceolatis, pilis stipitati, corollae valde infundibularibus, venatibus parallelis, notabilus, basibus intus.*

Succulent, perennial shrubs; stems to 50 cm long, much-branched, decumbent, to 1.2 m long. Leaves subopposite, erect, sessile or with short petioles, 0.8-3.5 mm long, the blades elliptic, 8-15 mm long, 2-3.5 mm wide, stipitate-glandular, succulent, entire, apically obtuse, bases cuneate. Inflorescences of solitary flowers in upper leaf axils, peduncles filiform, stipitate-glandular, 3-6 (-12) mm long; calyx campanulate, 3-3.5 mm wide at anthesis, stipitate-glandular, the tube 2.5-3 mm long, 2.5-3.5 mm wide; 5-lobed, the lobes lanceolate, equal, 3-6 mm long, 1.5-2 mm wide; corollas narrowly infundibuliform, 16.5-20 mm long, 5-lobed, the lobes 2-3 mm long, 5-8.5 mm wide, retuse, light purple, internally glabrous, externally stipitate-glandular; stamens 5, included, filaments inserted on lower third of corolla, unequal, three 9-11 mm long, two 12-14 mm long, pilose at the bases; anther thecae 2-2.5 mm long, 1-1.5 mm wide, purple, glabrous. Ovary glabrous, basal nectary, 5 carpels, the style included, 7-9 mm long, the stigma capitate, green, ca. 1 mm in diameter. Mericarps 5, unequal, 3.5-4.5 mm long, 5-7 mm in diameter, included within the persistent calyx.

Flowering: (October) November-December.

Etymology: This species is named for the Santuario of Our Lady of Chapi where the religious icon, Virgin de Chapi, resides southwest of Arequipa. Legend has it that the shrine of the Virgin de Chapi was being moved by a priest in 1790, and allegedly it grew so heavy that it became impossible to go any further. In 1884, the statue was transferred to a rustic chapel and a Mercedarian missionary built a church, finished in 1897, and promoted pilgrimages from Arequipa. The sanctuary is frequently called the «Little Lourdes» because of a great number of miraculous healings attributed those that have completed the long pilgrimage from Arequipa during the first week of May. In 2001, the church was damaged by an earthquake and has yet to be rebuilt.

Distribution and ecology: Known only from the type locality near the village of Chapi (16°45.51'S, 71°19.72'W) ca. 45 kms southeast of Arequipa and a distance of nearly 60 kms north from the coast. This arid locality has vegetation typical of

Fig. 7. *Nolana chapiensis* M.O. Dillon & Quipuscoa. A. Habitat south of Chapi; B. Habitat including *Browningia candelaris*; C. Habit; D. Corollas

Fig. 8. *Nolana chapiensis* M.O. Dillon & Quipuscoa. A. Close-up of flowers; B. Close-up of calyx; C. Close-up of mericarps, D. Virgin of Chapi.

Fig. 9. *Nolana chapiensis* M.O. Dillon & Quipuscoa. Herbarium sheet of *Dillon et al 9019* (F).

southern desert sites including the following species: *Browningia candelaris* (Meyen) Britton & Rose, *Cumulopuntia sphaerica* (C.F. Först.) E.F. Anderson, *Oreocereus hempelianus* (Gürke) D.R. Hunt (all Cactaceae), *Hoffmannseggia prostrata* Lag. ex DC. (Fabaceae), *Tiquilia grandiflora* (Phil.) A.T. Richardson (Boraginaceae), *Fagonia chilensis* Hook. & Arn. (Zygophyllaceae), *Allonia incarnata* L. (Nyctaginaceae), *Exodeconus flavus* (I.M. Johnston) Axelius & D'Arcy, *Exodeconus pusillus* (Bitter) Axelius, *Solanum peruvianum* L. (all Solanaceae), *Cristaria multifida* Cav. (Malvaceae), *Cistanthe celosioides* (Philippi) Carolin ex Hershkovitz (Portulacaceae), *Malesherbia arequipensis* Ricardo (Malesherbiaceae), *Gilia glutinosa* Phil. (Polemoniaceae), *Encelia canescens* Lam., *Ambrosia artemisioides* Meyen & Walp. ex Meyen, *Baccharis salicifolia* (Ruiz & Pav.) Pers., *Pluchea chingoyo* (Kunth) DC., and *Trixis calcalioides* Kunth. (all Asteraceae).

Relationships: This distinctive species most closely resembles *N. laxa* (Miers) I.M. Johnst. or *N. weberbaueri* I.M. Johnst., both annual species with petiolate leaves, the blades lanceolate to ovate, and distributions further north in the vicinity of Lima and Ica respectively. *N. chapiensis* is immediately distinguished from these taxa by its perennial, shrubby habit, elliptic leaves lacking a well-defined petiole, and distinctive corollas with guides in the throat. *N. laxa* is further distinguished by typically possessing three large mericarps, whereas *N. chapiensis* invariably possesses five mericarps.

Utilizing the GBSSI or waxy marker (Dillon et al., 2007b), *N. chapiensis* is grouped with in a largely unresolved clade of Peruvian species that includes *N. scaposa* Ruiz & Pav., *N. lezamae, N. humifusa, N. aticoana, N. urubambae* Vargas, *N. spathulata* and *N. laxa*. Further studies will be necessary to establish species relationships amongst this group of species.

Additional material examined: Peru. **Dpto. Arequipa**. Prov. Arequipa. Alrededores de la Gruta de la Virgen de Chapi, 16º 45´S-71º 19´O, 2240 m, 23 Nov 2005, *M.O. Dillon, S. Leiva, V. Quipuscoa, M. Zapata, E. Ortiz, G. Castillo & M. Corrales 9019* (F, HAO, HUSA, HUT, US); Polobaya, abajo de la Gruta de la Virgen de Chapi, 16º 45.9´S-71º 19.6´O, 2260 m, 14 Dic 2002, *V. Quipuscoa, N. Hidalgo, D. Sotomayor, M. Rodríguez & A. Hopkins 2850* (HAO, HUSA); a 4 Km del Santuario de Chapi, camino a la Gruta, 16º 45,12´S-71º 19,22´O, 2250 m, 20 Oct 2002, *V. Quipuscoa, M.O. Dillon, L. Cáceres, G. Castillo, M. Laura, Y. Cano & Y. Chilque 2785* (HAO, HUSA).

5. ***Nolana lezamae*** M.O. Dillon, S. Leiva & Quipuscoa, sp. nov. (Fig. 10-11).

TYPE: PERU. **Dpto. Ancash.** Prov. Corongo, Dist. Corongo. Tres Cruces (entre La Pampa-Yuramarca), [8°41'LS, 77°55'LO], 2144 m, 30 Jun 1998, *S. Leiva G., V. Quipuscoa, P. Lezama A. & E. López 2212* (holotype: HAO, isotypes: F, HUSA).

Nolana humifusa *primo adspectu maxime simile, sed laminae foliis 2-3 mm latibus, linearibus vel spathulatibus, calycibus bilabiatibus leniter, corollae infundibularibus angustae, pilis stipitati.*

Succulent, perennial herbs; stems prostrate, flexulose, 50-160 cm long, much-branched, minutely glandular pubescent, reddish. Leaves verticilate, erect, sessile, the blades linear, 23-33 mm long, 2-3 mm wide, glabrous, succulent, entire, apically acute, bases cuneate. Flowers solitary, peduncles filiform, glabrous, (5-) 9-13 mm long; calyx campanulate, 4-4.5 mm wide at anthesis, glabrous, the tube 4-4.5 mm long, 5-6 mm wide; 5-lobed, bilabiate, the lobes deltoid, subequal 6-7 mm long, 3.5-4.5 mm wide; corollas narrowly infundibuliform, 18-20 mm wide, deep purple, internally glabrous, externally pubescent, the trichomes uniseriate and glandular, the tube 14.5-15 mm long, 27-28 mm wide, 5-lobed, the lobes obtuse, 2.5-3 mm long, 9-10 mm wide, the central acumen obtuse; stamens 5, included, filaments inserted on lower third of corolla, unequal, three 2-3 mm long, two 3.5-4.5 mm long, pilose at the bases; anther theca 1.5-2 mm long, 1-1.5 mm wide, purple, pubescent with multicellular trichomes. Ovary glabrous, 1.4-1.5 mm long, 1.8-2 mm wide, basal nectary, 5 carpels, the style

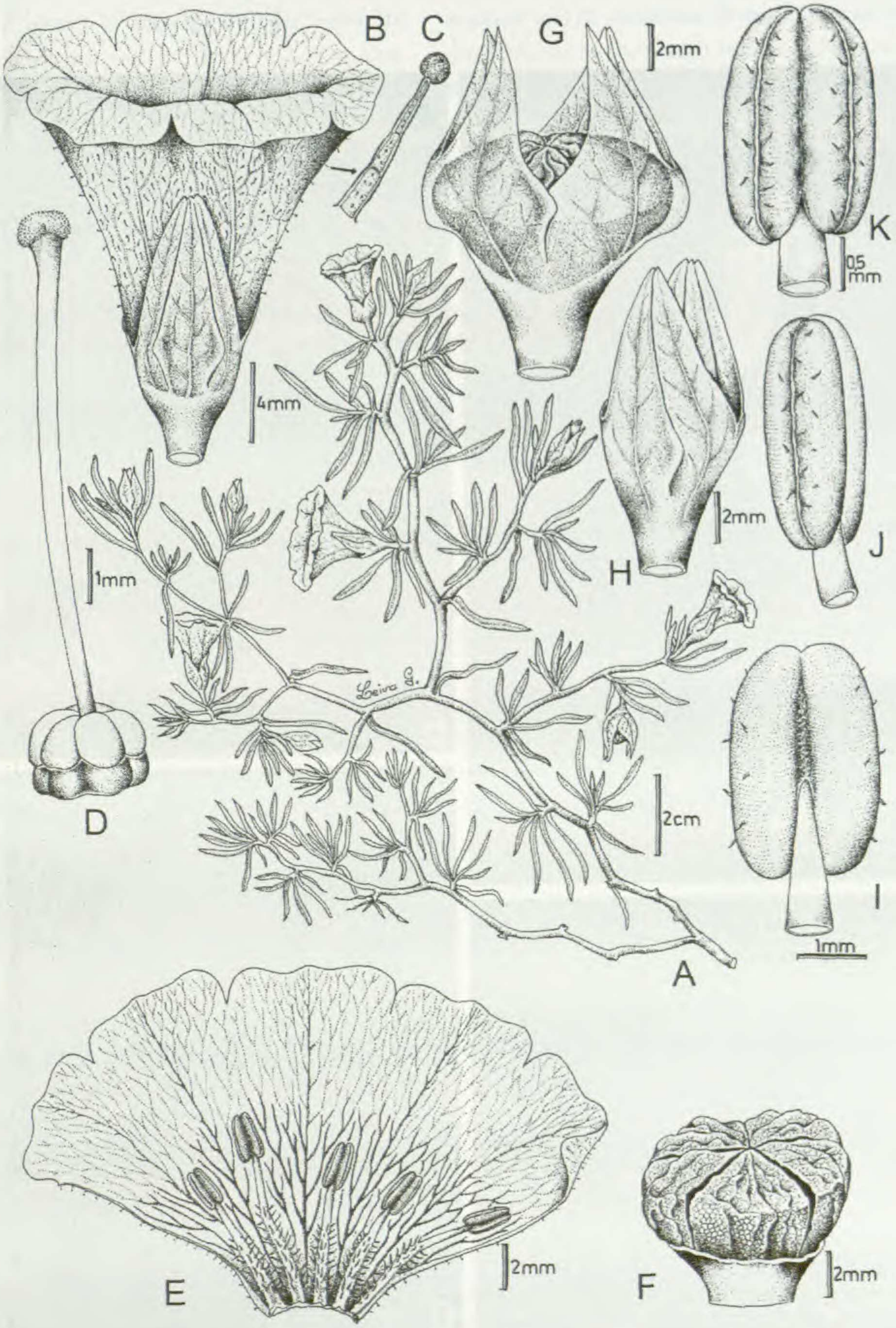

Fig. 10. *Nolana lezamae* M.O. Dillon, S. Leiva & Quipuscoa. A. Habit; B. Flower; C. Detail of floral trichome; D. Gynoecium; E. Dissected corolla; F. Mericarps; G. Calyx expanding with mericarps; H. Calyx with connate lobes; I. Anther dorsal view; J. Anther lateral view; K. Anther ventral view. (Drawing of holotype collection, *Leiva et al. 2212,* HAO).

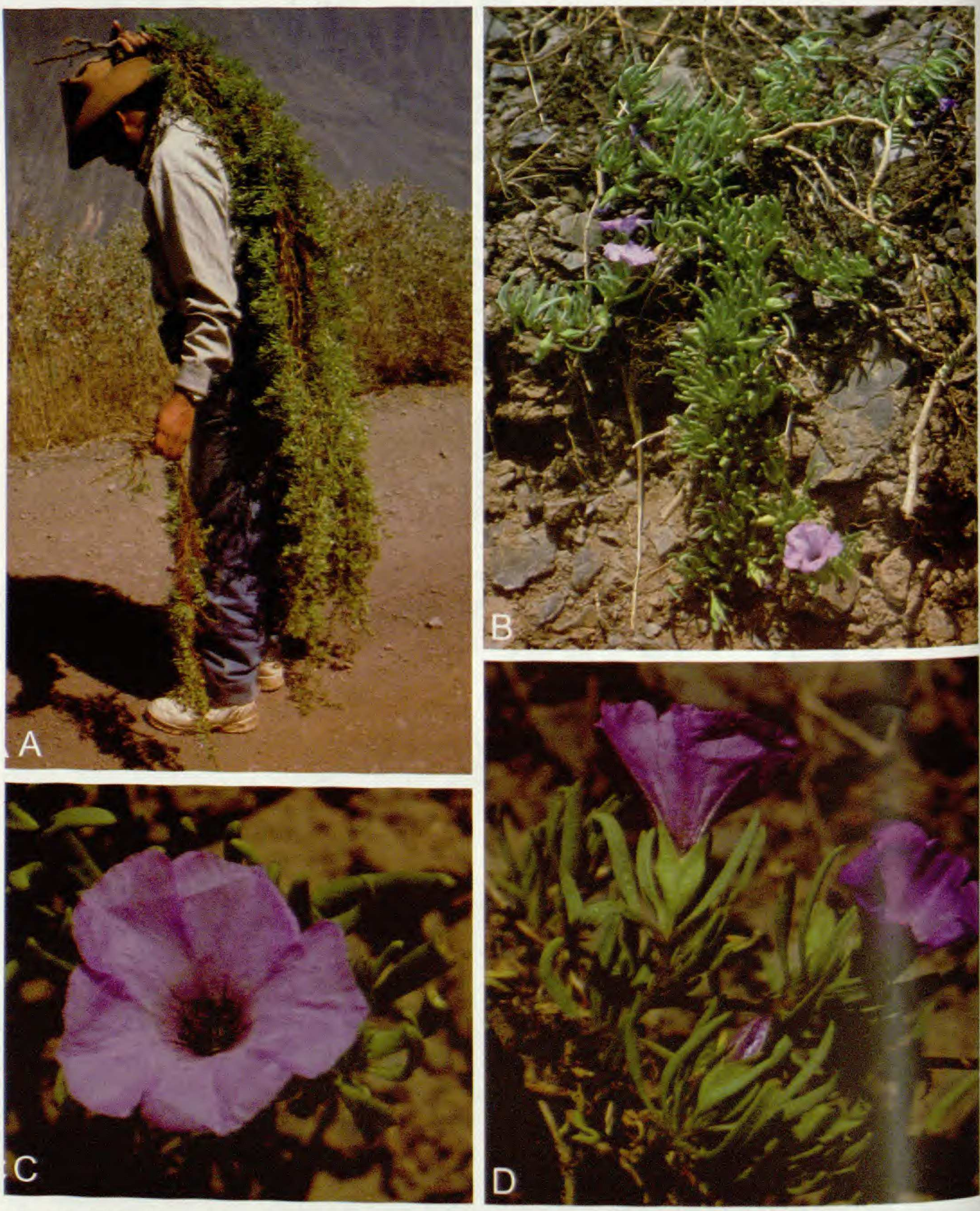

Fig. 11. *Nolana lezamae* M.O. Dillon, S. Leiva & Quipuscoa. Photographs of A. Victor Quipuscoa holds a single plant by their roots in each hand; B. Habit showing prostrate stems; C. Close-up of corolla; D. Lateral view showing calyx and corolla.

included, 7-7.5 mm long, the stigma capitate, green, sub-lobate, ca. 1 mm in diameter. Mericarps 5, 3.5-4.5 mm long, 8.5-9 mm in diameter, included within the expanding calyx; each with 2-3 seeds, ca. 1.5 mm long, ca. 1 mm wide.

Flowering: (June) November-December.

Etymology: This species is named for Mg. Pedro Lezama Asencio, professor at Universidad Privada Antenor Orrego in Facultad de Medicina, Laboratorio de Bioquímica. Pedro was born and raised in Corongo, Ancash, a village not far from the type locality, and he was instrumental in efforts to collect material of this new species. He has been an enthusiastic member of many collecting expeditions throughout Peru and a close friend and colleague to the authors.

Distribution and ecology: Known only from the type locality near Tres Cruces in the Province of Corongo, Ancash (8°41'S, 77°55'W). This species is restricted but frequent within a small pocket of arid vegetation with some of the associated species having disjunct distributions from the coastal *lomas* formations and include: *Melocactus peruvianus* Vaupel (Cactaceae), *Chenopodium petiolare* Kunth (Chenopodiaceae), *Alternanthera halimifolia* (Lam.) Standl. ex Pittier (Amaranthaceae), *Grabowskia boerhavifolia* (L.f.) Schlecht., *Lycium americanum Jacq.*, *Solanum peruvianum* L. (all Solanaceae), *Ophryosporus* sp. (Asteraceae), *Hoffmanseggia* sp. (Fabaceae), *Puya* sp., *Deuterochonia longipetala* (Baker) Mez (both Bromeliaceae), *Jathropha* sp., *Euphorbia weberbaueri* Mansfeld, *Cnidoscolus* sp. (Euphorbiaceae), *Peperomia dolabriformis* Kunth (Piperaceae), and *Stipa ichu* (Ruiz & Pav.) Kunth (Poaceae).

Relationships: The overall morphology of *N. lezamae* suggests *N. humifusa*, a species confined to coastal *lomas* environments of northern Peru; however, the latter species is distinguished by its elliptic to ovate leaves and spurred calyx. The presence of trichomes on the anther thecae is an unusual character shared by *N. humifusa* and *N. lezamae*.

Utilizing the GBSSI or waxy marker (Dillon et al., 2007b), *N. lezamae*, is grouped with *N. aticoana*, *N. humifusa*, and *N. urubambae*, all species that are readily distinguished by their larger laminar leaves and floral morphology. Further studies will be necessary to establish the species relationships amongst these taxa.

Additional material examined: PERU. **Dpto. Ancash**. Prov. Corongo, Dist. Corongo. Tres Cruces (entre La Pampa-Yuramarca), 2280 m, 4 Dec 1998, *S. Leiva G., P. Lezama A. & M.O. Dillon 2241* (HAO, F, HUSA); Tres Cruces, 2040 m, 5 Dec 1998, *S. Leiva G., P. Lezama A. & M.O. Dillon 2250* (HAO, F, HUSA).

Taxonomic Notes

Nolana coronata Ruiz & Pav.

Nolana coronata Ruiz & Pav. was validly published in *Flora Peruviana et Chilensis* (v. 2: 7, tab. CXIIb. 1799), and was typified by a collection attributed to *Tafalla s.n.* (holotype, M; isotypes, F, USM) from near Atiquipa. These collections have ovate to lanceolate leaves with obvious petioles and five mericarps joined at their faces as pictured in the plate (Fig. 12b) . Ivan M. Johnston may have begun the confusion in the application of the name by determining a narrow-leaved collection (*Raimondi 10856*, B) with large inflated calyces as *N. coronata*. Ferreyra (1961) obviously followed Johnston's concept for *N. coronata* and determined a suite of collections as *N. coronata*, all with narrow to linear leaves and large flowers with inflated calyces, e.g., *Ferreyra 11727* (USM), *Ferreyra 11745* (USM), *Hutchinson 1288* (USM), and *Rahn 063* (USM). All these collections are here considered as material of *N. chancoana*, a species with linear learves and inflated calyx, quite distinct from authentic material of *N. coronata*.

Nolana minor Ferreyra

Ferreyra (1955) described *Nolana minor*, a minute, erect, succulent annual to five centimeters tall. It is only known from the type collection at the type locality at La Punta, an ocean front locality just south of Camaná. With small succulent, terete leaves and only two mericarps, this species would appear related to *N. arequipensis* and *N. thinophila*. Repeated attempts

to locate this rare species have not been successful. The area around La Punta has been the site of extensive housing developments, and in 2001, the earthquake that hit southern Peru caused a tsunami that inundated the beachfront of the Camaná area. Given that *N. minor* has not been recollected since the type was gathered in November 1947, it is feared that this rare species may be extinct.

Nolana revoluta Ruiz & Pav.

Johnston (1936) discussed the classification of *Nolana revoluta* Ruiz & Pav., a species typified only with an illustration *Flora Peruviana et Chilensis* (v. 2: 8, tab. CXIIIb. 1799) (Fig. 13b). He admitted confusion about the application of the name for a southern Peruvian taxon, since it was only known from the published plate and no corresponding specimen had been identified. Given his doubts, Johnston chose to place it into «Questionable and excluded Species» with the statement that «The only other Peruvian plant at all suggestive of *N. revoluta* is the one I am describing as *N. pallida*, which incidentally does come from the province of Camaná, but that plant differs in shape of the corolla, the very different calyx, it strong perennial root, very woody stem, not evidently veined leaves, etc.»

There appears to be considerable diversity among species with stellate pubescence in southern Peru with phenotypically variable taxa attributed to *Nolana pallida* and *N. tovariana*. Further sampling and analysis will be needed to confirm species boundaries in the *N. revoluta-pallida-tovariana* complex but the name *N. revoluta* may be resurrected and applied to southern Peruvian elements in this complex.

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Fig 13

Fig 12

Fig. 12. *Nolana inflata* and *N. coronata*. Drawings from *Flora Peruviana et Chilensis*, p. 113.
Fig. 13. *Nolana spathulata* and *N. revoluta*. Drawings from *Flora Peruviana et Chilensis*, p. 114.

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